

Appl. No. 10/612,859
Examiner: Thao P Le, Art Unit 2818
In response to the Office Action dated October 28, 2004

Date: January 27, 2005
Attorney Docket No. 10112421

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AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims

Claim 1 (Currently amended): A method of forming shallow trench isolation with chamfered corners, comprising:

forming a pad insulating layer, a first mask layer, and a second mask layer on a substrate;

patterning the second mask layer, the first mask layer, and the pad insulating layer to form an opening exposing a portion of the substrate;

etching the substrate using the patterned second mask layer as a mask to form a trench in the substrate;

~~removing part of~~ pulling back the second mask layer a predetermined distance by wet etching to expose the first mask layer adjacent to the trench and result in the second mask layer having a tapered profile; and

etching the second mask layer, the first mask layer, the pad insulating layer, and the substrate along the tapered profile of the second mask layer by anisotropic etching to chamfer corners of the trench.

Claim 2 (Original): The method of forming shallow trench isolation with chamfered corners of claim 1, wherein the pad insulating layer is silicon dioxide.

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Claim 3 (Original): The method of forming shallow trench isolation with chamfered corners of claim 1, wherein the first mask layer is silicon nitride.

Claim 4 (Original): The method of forming shallow trench isolation with chamfered corners of claim 1, wherein the second mask layer is a layer of boro phosphor silicate glass (BPSG), phosphor silicate glass (PSG), boro silicate glass (BSG), or arsenic silicate glass (AsSG).

Claim 5 (Canceled).

Claim 6 (Original): The method of forming shallow trench isolation with chamfered corners of claim 5, wherein the wet etching uses a solution of ammonium hydrogen peroxide mixture (APM).

Claim 7 (Previously presented): The method of forming shallow trench isolation with chamfered corners of claim 1, further comprising, after chamfering the corners of the trench, steps of:

- completely removing the second mask layer;
- etching the first mask layer and the pad insulating layer to remove a predetermined width thereof to expose a portion of the substrate adjacent to the trench;
- blanketly forming an insulator layer on the exposed surface of the substrate and the chamfered corners thereof to fill the trench; and
- flattening the insulator layer, and removing the first mask layer and the pad insulating layer to form a trench isolation region.

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Claim 8 (Original): The method of forming shallow trench isolation with chamfered corners of claim 7, wherein the trench of the trench isolation region has a Y-shaped cross-section.

Claim 9 (Original): The method of forming shallow trench isolation with chamfered corners of claim 7, wherein etching of the first mask layer and the pad insulating layer to remove a predetermined width thereof to expose a portion of the substrate adjacent to the trench uses wet etching.

Claim 10 (Original): The method of forming shallow trench isolation with chamfered corners of claim 9, wherein the wet etching uses a solution of hydrofluoric acid/ethylene glycol mix (HF/EG).

Claim 11 (Original): The method of forming shallow trench isolation with chamfered corners of claim 7, wherein blanketly forming the insulator layer to fill the trench uses high-density plasma chemical vapor deposition (HDPCVD) or low pressure chemical vapor deposition (LPCVD).

Claim 12 (Original): The method of forming shallow trench isolation with chamfered corners of claim 7, further comprising, before forming the insulator layer, forming a shield layer on the surface of the substrate, the trench, and the chamfered corners.

Claim 13 (Previously presented): The method of forming shallow trench isolation with chamfered corners of claim 12, wherein the shield layer is a liner oxide layer formed by thermal oxidation.

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Claim 14 (Currently amended): A method of forming shallow trench isolation with chamfered corners, comprising:

forming a pad oxide layer, a first mask layer, and a second mask layer on a substrate,;
patterning the second mask layer, the first mask layer, and the pad oxide layer to form an opening exposing a portion of the substrate;

etching the substrate using the patterned second mask layer as a mask to form a trench in the substrate;

~~removing part of~~ pulling back the second mask layer a predetermined distance by wet etching to expose the first mask layer adjacent to the trench and result in the second mask layer having a tapered profile;

etching the second mask layer, the first mask layer, the pad insulating layer, and the substrate along the tapered profile of the second mask layer by anisotropic etching to chamfer corners of the trench;

completely removing the second mask layer;

forming a liner oxide layer on the surface of the substrate, the trench, and the chamfered corners.

blanketly forming an insulator layer on the exposed surface of the substrate and the chamfered corners thereof to fill the trench; and

flattening the insulator layer, and removing the first mask layer and the pad oxide layer to form a trench isolation region.

Claim 15 (Original): The method of forming shallow trench isolation with chamfered corners of claim 14, wherein the insulator layer is flattened by CMP.

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Claim 16 (Original): The method of forming shallow trench isolation with chamfered corners of claim 14, wherein the first mask layer is silicon nitride.

Claim 17 (Original): The method of forming shallow trench isolation with chamfered corners of claim 14, wherein the second mask layer is a layer of BPSG, PSG, BSG, or AsSG.

Claim 18 (Original): The method of forming shallow trench isolation with chamfered corners of claim 14, wherein the wet etching uses a solution of APM.

Claim 19 (Original): The method of forming shallow trench isolation with chamfered corners of claim 14, wherein the trench of the trench isolation region has a Y-shaped cross-section.

Claim 20 (Original): The method of forming shallow trench isolation with chamfered corners of claim 14, wherein blanketly forming the insulator layer to fill the trench uses HDPCVD or LPCVD.

Claim 21 (Previously presented): The method of forming shallow trench isolation with chamfered corners of claim 14, wherein the liner oxide layer is formed by thermal oxidation.

Claim 22 (Original): The method of forming shallow trench isolation with chamfered corners of claim 14, further comprising, after removing the second mask layer, etching the first mask layer and the pad oxide layer to remove a predetermined width thereof to expose a portion of the substrate adjacent to the trench.

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Claim 23 (Original): The method of forming shallow trench isolation with chamfered corners of claim 22, wherein etching of the first mask layer and the pad oxide layer uses wet etching.

Claim 24 (Original): The method of forming shallow trench isolation with chamfered corners of claim 23, wherein the wet etching uses a solution of HF/EG

Claim 25 (New): The method of forming shallow trench isolation with chamfered corners of claim 1, wherein the second mask layer is pulled back by wet etching with the predetermined distance of 150~250Å.

Claim 26 (New): The method of forming shallow trench isolation with chamfered corners of claim 14, wherein the second mask layer is pulled back by wet etching with the predetermined distance of 150~250Å.